

FIG. 1

**Growth parameters and characterization results of Samples A-D**

|                                                    | Sample A                | Sample B          | Sample C                  | Sample D                    |
|----------------------------------------------------|-------------------------|-------------------|---------------------------|-----------------------------|
| Final Ge composition                               | 100%                    | 100%              | 50%                       | 100%                        |
| Grading rate (%Ge $\mu\text{m}^{-1}$ )             | 5                       | 10                | 10                        | 10                          |
| Total epitaxial thickness ( $\mu\text{m}$ )        | 23                      | 12                | 6.5                       | 12                          |
| Growth temperature ( $^{\circ}\text{C}$ )          | 750                     | 800               | 750                       | 50-76%: 750<br>76-100%: 550 |
| Growth pressure (mT)                               | 25                      | 50                | 25                        | 50-76%: 25<br>76-100%: 3    |
| CMP at 50%                                         | No                      | No                | —                         | Yes                         |
| Threading dislocation density ( $\text{cm}^{-2}$ ) | $1 \pm 0.1 \times 10^7$ | $1-5 \times 10^7$ | $6.3 \pm 0.1 \times 10^6$ | $2.1 \pm 0.2 \times 10^6$   |
| Crack density ( $\text{cm}^{-1}$ )                 | $47 \pm 5$              | 0                 | 0                         | 0                           |
| Particle density ( $\text{cm}^{-2}$ )              | $1250 \pm 100$          | $600 \pm 40$      | $50 \pm 5$                | $150 \pm 10$                |
| RMS roughness (nm)                                 | 35.9                    | 47                | 37.3                      | 24.2                        |
| $a_{\perp}$ of top layer ( $\text{\AA}$ )          | 5.6559                  | 5.6558            | 5.5327                    | 5.6597                      |
| $a_{  }$ of top layer ( $\text{\AA}$ )             | 5.6559                  | 5.6552            | 5.5352                    | 5.6409                      |

FIG. 2

FIG. 3

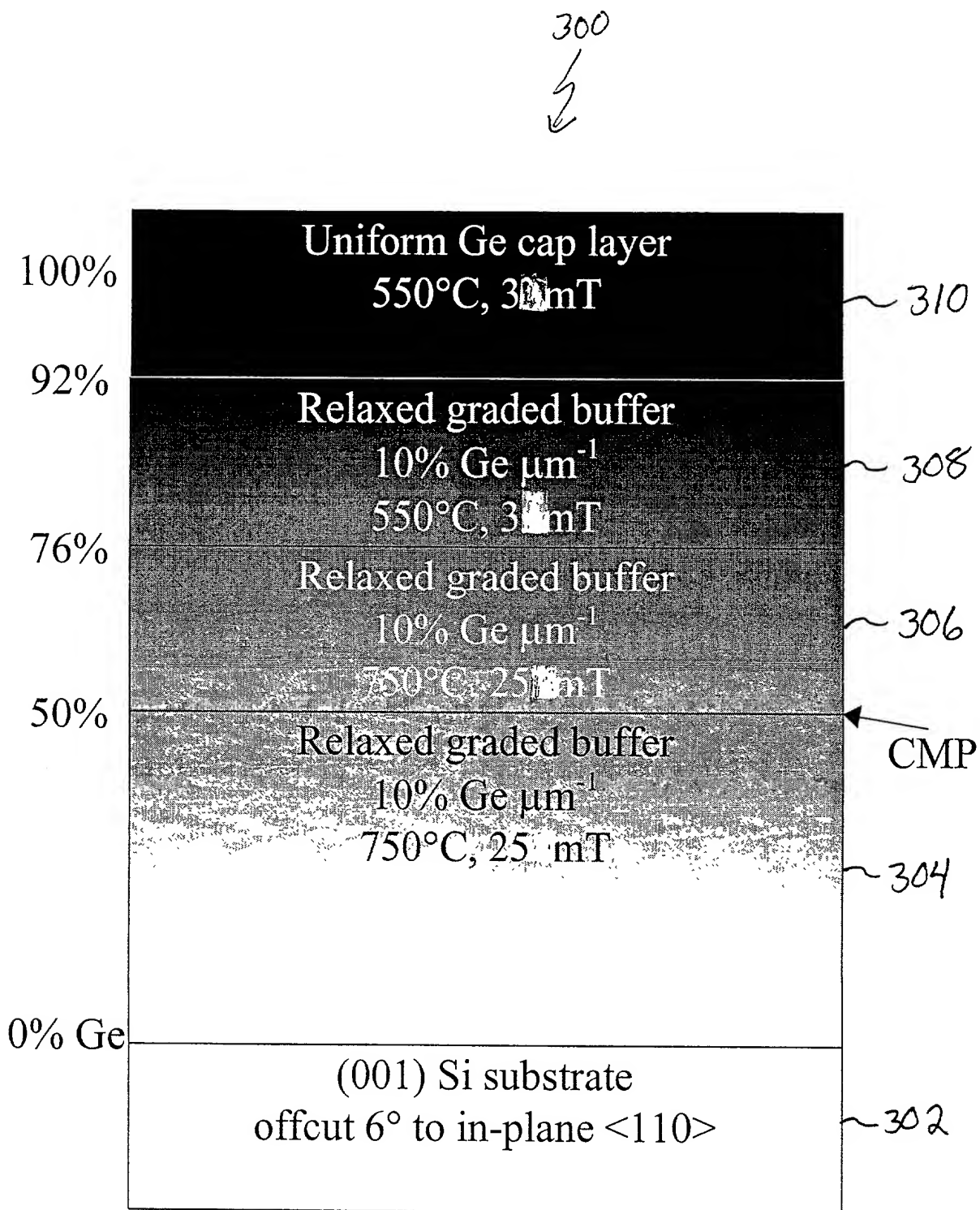


FIG. 3

10022689 43701

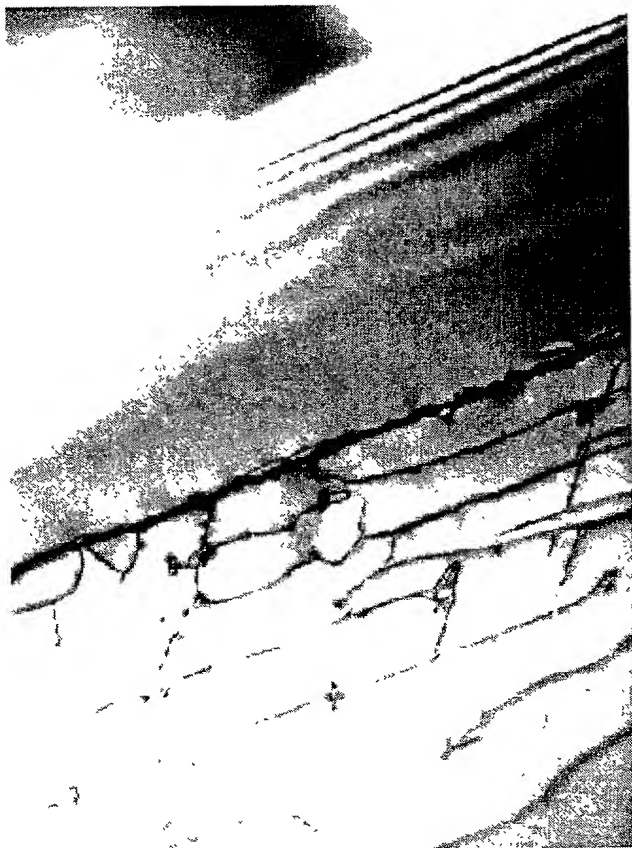


FIG. 4

FIG. 5A

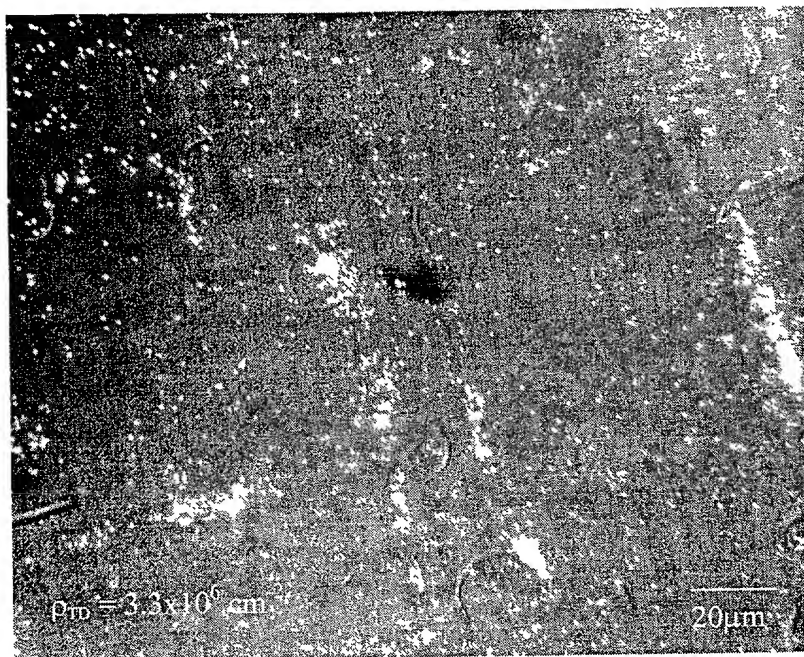


FIG. 5B

